the need of a general treatise on the more difficult problems in the mechanics of the atmosphere; the outline of a work on the special relations of the climate to the crops: these are among the numerous questions that will bear discussion.

In his recent testimony before the House Committee on Agriculture, January 16, 1904, the Secretary of Agriculture said:

With regard to our educational work I want to call your attention to what we are doing in several States. It has been the theory of the Committee on Agriculture of the House that we should cooperate with the States, and we are doing a good deal of that; in fact, we are doing a great deal of it. We are not only doing that, but we are helping educational institutions throughout the country. Some years ago there was not a lecture delivered anywhere in the United States on meteorology. We have furnished the services of 14 gentlemen to lecture in universities and colleges in the States, for the purpose of having, eventually, scholars in the land along these lines.

I gave instructions to Mr. Moore lately to bring those 14 gentlemen—they are observers in certain localities who incidentally lecture to these colleges and universities (Yale was the last institution that applied for one)—into a summer school in Washington and strengthen their lectures, so that when they go out to entertain classes they can do it with effect, to the end that some of those students in meteorology will find their way here and enable us to do better work some day.

WEATHER FORECASTS BY LOCAL OBSERVERS.

A recent letter from the professor in charge of meteorological observations and instruction at one of our cooperating colleges, and who is also a voluntary observer of the Weather Bureau, after enumerating the instruments and apparatus at his disposal goes on to say:

We have gone to considerable expense, all by hard subscription, to make our equipment sufficient in the study of climatological conditions, and no effort shall be spared to add what may yet be wanting in the magnetic and seismic lines, not to omit the astronomical department, which is well under way.

With the instruments on hand we have already been able to do some local forecasting, which very generally agrees with the forecasts from the Weather Bureau, but which is on the whole more accurate and reliable for our special locality, a fact which the community around begins to recognize. Now, if this observatory can be, over and above mere voluntary observation, of any service to the Weather Bureau, I am sure we will cheerfully place it at your disposal.

The above quotation presents a condition of affairs typical of that at many other institutions in this country. After thirty years of hard work, the Weather Bureau has been able to convince the people that the movements of the broad general features of atmospheric conditions can be forecast, and that too, profitably, by a discreet use of the information displayed upon the daily weather chart. Without this weather chart nothing at all could be done, but with its help one may foresee quite closely in what direction the front of a cold wave or of an area of rain or snow will move. We may often predict from day to day the motions of a whirling center of windstorm with a high percentage of accuracy, but the occurrence of rain or snow at any locality is a much more difficult matter.

The growing conviction that the atmosphere is subject to the laws of mechanics; that the weather can be predicted from day to day, and that eventually reliable long-range forecasts may be possible, has stimulated thought and research in all directions, and during these thirty years weather bureaus, weather maps, forecasts, and learned meteorologists have sprung up in all parts of the world. In our own country, a solid foundation for future progress is being made by the introduction of the study of meteorology into schools and colleges where it had hitherto been entirely neglected. This is the status of the institution from which the above quoted letter was received. It is doing a splendid work in stimulating the study of the subject, and among its students it will, we hope, raise up some who will be prominent meteorologists in the future. It desires to do forecast work, but it would be anticipating matters by a generation or two to imagine that a single observatory by itself can undertake with success the work of local weather predictions.

It is now a hundred years since the meteorological society at Mannheim finished its work of publishing that collection of daily observations which Brandes used in compiling his daily weather maps. From that time to this it has been evident that it is the combination of many stations into one chart that must be the basis of weather predictions. Only in the case of an isolated island like Mauritius does one feel driven by necessity to base a guarded forecast of an approaching typhoon on the local indications of pressure, wind, and cloud. The local forecasts made by every unofficial forecaster in the United States, so far as we have yet heard of them, depend upon the stars and the cycles, and are utter nonsense, or else they depend upon the daily weather map, and are only slight modifications of, or identical with, the official Weather Bureau forecasts. In fact, the Weather Bureau employs many men who are familiar with the study of weather maps, and it is hardly likely that these will on any given occasion fail to make as good forecasts as anybody else can make from the same data. Our work is open to all, and it is perfectly allowable for anyone to modify our forecasts or make new ones if he chooses for his own personal use, but it is certainly a very ungracious procedure for a man to make forecasts based on our data and then proclaim himself as superior to the Weather Bureau, or lead his community to think that he knows more about the subject than we. Such a course may magnify him in the eyes of his community; may bring funds and support for his college; may increase the circulation of the newspaper that publishes his forecasts; may increase his importance as a popular success, and yet, at the bottom, all his good work must depend upon the same data, rules, and laws that are employed by the Weather Bureau. The success of one forecaster and the failure of another is a matter peculiar to the man, not to the system.

The Weather Bureau is especially interested in having our colleges and universities prepare young men for future meteorological work in the Bureau by drilling them in meteorology and all the branches of physics that bear thereon. Of meteorology we may say something analogous to that recently said by Mr. George A. Damon of electricity; namely:

The leaders in the various branches of the electrical industry during the first developments, when electrical work was an art and not a science, were graduates from the well-known university of "Hard Knocks." The men of the second generation of workers who are now doing things are largely the product of a semiscientific training in schools of technology, supplemented by experience of a practical nature picked up in a more or less haphazard way. A few years more will see the development of a third and better prepared generation of electrical experts, and it is safe to say that they will be the result of a combination of practical training thoroughly mixed with theoretical education. It must be expected that the next generation will be superior to the present one.

NEW ASTROPHYSICAL AND METEOROLOGICAL OBSERVATORIES.

The last number of Gerland's Beiträge zur Geophysik, vol. 6, p. 534, contains a short report on the establishment of an astrophysical observatory near Tortosa, in the Province of Tarragona, in eastern Spain (latitude 40° 48′ north, longitude 0° 33′ east of Greenwich). This observatory consists of a number of separate buildings for the respective instruments and observers that belong to the establishment. The institution is located on a delightful hill which overlooks the beautiful valley of the Ebro, and is, therefore, called the Observatory of the Ebro. The principal object of this establishment will be the study of terrestrial magnetism, considered not only by itself, but especially in relation to other phenomena, such as atmospheric electricity, meteorology, earthquakes, microseismic movements, and solar phenomena. Two buildings will be devoted to magnetic work; one to astronomical and solar work; a fourth to meteorology and atmospheric electricity; a fifth to the continuous register of thunderstorms, the record of earth temperatures, the polarization of sky light,

and the solar radiation as measured by actinometers. The building for the work in seismology will be entirely subterranean. The habitual purity of the sky, the entire absence of electric tramways, and of whatever may produce magnetic perturbations render this a favorable location. The observatory is in the neighborhood of the principal college of the Jesuits, namely, the college of higher studies, so that those who expect to be sent to the Observatory at Manila will receive preparatory education in observatory work. Fortunately, this observatory is also in the belt of totality for the eclipse of 1905, and it is hoped that everything will be in readiness for special work on that occasion.

In 1902 an important observatory for astronomy, geodynamics, and meteorology was established by the Society of Jesuits in Grenada, Spain, and its first annual volume of monthly bulletins for the year 1903 has been published. A still older seismologic station is a part of the marine observatory located at San Fernando, near Cadiz, Spain, and represents the high table-land of that region. At this station a Milne pendulum is established, whereas at the Ebro Observatory there is at present a microseismograph by Vicentini, and a horizontal pendulum by Grablovitz.

In so far as observatories for seismology, earth currents, solar phenomena, magnetism, tides, or astronomy maintain also records and studies bearing upon meteorology, we must welcome their indefinite multiplication. As yet we have but a fragmentary knowledge of the earth's atmosphere, and although it seems like accumulating an unmanageable mass of details, yet eventually all will be coordinated properly. The present state of astronomy is the result of just such a similar accumulation of details; crude records that are two thousand years old have been combined with those that are two hundred years old, and even with the most accurate work of the present day, in order to perfect our knowledge of the movements of the heavenly bodies. Just so it will be in meteorology. The data as to storms, the pressures, temperatures, and winds that have been recorded during the past fifty years will be combined with the more complete data and weather maps of the whole world that will be available to our successors, in order that they may understand more perfectly than we the movements that appear to us so irregular and accidental.

A NEW MOUNTAIN OBSERVATORY.

By the joint efforts of the Italian Alpenverien, the Duke of Abruzzi, the Minister of Agriculture for Italy, and Queen Margarhita, a geophysical observatory on the summit of Monta Rosa, at an altitude of 4560 meters (14,961 feet), has at last been erected. It is the highest in Europe except that of Vallot on Mont Blanc, and higher than the station on Pikes Peak formerly occupied by the Weather Bureau. The regular observational activity will begin in the summer of 1904. Young men expert in meteorological and physical laboratory work will be appointed as assistants. It will be occupied in the winter time as well as in the summer if the severity of the weather does not prevent. Both the observatory and the hut of refuge for mountaineers will be accessible, not only to Italian but to foreign students who wish to carry on geophysical investigations therein. In fact, it was used for that purpose last summer. The meteorological observations are expected to be of especial importance in connection with the simultaneous international balloon ascensions. Italy now possesses three mountain observatories, namely, Monta Rosa, 4560 meters; Ætna, 2942 meters; Cimone, 2162 meters.

KITE ASCENSIONS AT KAZAN.

During the summer and autumn of 1893 a Richard meteorograph was sent up to considerable heights at the University of Kazan by Prof. V. A. Uljanin, professor of physics and director of the meteorological observatory. The Hargrave kites were used, with surfaces of about two to three meters square. The meteorograph was carried either between two small kites or by one large kite. The first four ascensions gave the following general average temperature gradient per 100 meters altitude:

1903, July 18, 1.23° C., up to 858 meters.
1903, September 1, 0.88° C., up to 635 meters.
1903, September 5, 1.08° C., up to 1270 meters.
1903, October 1, 0.85° C., up to 766 meters.

POLARIZATION OF THE LIGHT OF THE SKY.

The observation of the polarization of sky light is a matter that has interested meteorologists ever since the early work by Arago, Babinet, and Brewster; it seemed to promise to give us some information with regard to the moisture, the dust, the mixture of warm and cold air, and even, according to the latest studies, the nature of the gases that are mechanically mixed together in the atmosphere. The latest contribution to this subject is published in the Meteorologische Zeitschrift for March, 1904, namely a series of observations on the polarization of sky light made by Dr. G. Sack in Lubeck. These are a continuation of the studies made by Dr. Busch in 1886–1889, which latter were stimulated by the optical effects produced by the volcanic eruption of Krakotoa in 1883. The work of Dr. Sack began as soon as he heard of the eruptions of Mount Pelée, Martinique, and Soufriere on St. Lucia, in the summer of 1902. He determined the neutral points of Babinet and Arago by means of a Savart polariscope. The observations extend from September, 1902, to the end of August, 1903, and the following general conclusions are announced by Dr. Sack:

1. The distances of Babinet's point from the sun and of Arago's from the antisun change in the same direction with the position of the sun at the time of its rising and setting.

2. The general law announced by Dr. Busch (Meteorologische Zeitschrift, December, 1886), can be expressed more generally as follows:

> The distance of the Babinet point from the sun increases until the sun is at a slight altitude above the horizon, when it has its maximum value, and decreases as the sun departs from this position; the distance of the Arago point from the antisolar point decreases until the sun attains a slight altitude below the horizon, when it has its minimum value, and increases as the sun departs from this position.

3. The effect of the eruption of the West Indian volcanoes is recognized by an astonishing increase in the distance of the Babinet point from the sun and a decrease of the distance of the Arago point from the antisun.

It will be remembered that in 1892 the Weather Bureau had an opportunity to employ one of our most distinguished American physicists, Prof. Carl Barus, now at Brown University, upon various problems in meteorology, especially the method and process of condensation of aqueous vapor in the atmosphere. A preliminary notice of his work was published in a report of the Chief of Bureau, 1891–2, pp. 526–8. His first results were published in the Weather Bureau Bulletin, No. 12, "Report on the Condensation of Atmospheric Moisture," by Carl Barus, Washington, 1895. The dates of the preface are May 1, 1893, and April, 1895, and the report presents the results of much work done after the position occupied by Dr. Barus had been abolished by Secretary Morton; he having been able to continue his work at his own expense, with some considerable assistance from Prof. Alexander Graham Bell. Bulletin No. 12, presenting the results obtained up to 1895, has been followed by a series of equally interesting and important papers published either in the London, Edinburgh, and Dublin Philosophical Magazine, or in the Contributions of the Smithsonian Institution. The latest results of this research, which is still being actively prosecuted, were communicated to the Ameri-